both numeric and narrative water quality standards in streams. While most states do not have numeric standards for nutrients, point source discharges of nutrients are recognized as a factor leading to stream degradation and failure to achieve narrative water quality standards. As a result, increasingly stringent limitations on nutrient concentrations in wastewater treatment plant effluent (particularly phosphorus) have been imposed in many areas.

In many cases the NPDES program has significantly cleaned up rivers and streams; however, many streams still do not meet water quality standards, even with increasingly stringent regulatory standards. Scientists and regulators now understand that the dominant source of nutrients in many streams is from nonpoint sources within the stream's watershed, not from point sources such as wastewater treatment plants. Typical land uses that contribute to the nonpoint contamination of streams are the application of fertilizers to agricultural fields and suburban lawns, the improper handling of animal wastes from livestock operations, and the disposal of human waste in septic systems. Storm runoff from agricultural fields can contribute nutrients to a stream in dissolved forms as well as particulate forms.

Because of its tendency to sorb to sediment particles and organic matter, phosphorus is transported primarily in surface runoff with eroded sediments. Inorganic nitrogen, on the other hand, does not sorb strongly and can be transported in both particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen also can be transported through the unsaturated zone (interflow) and ground water to waterbodies. **Table 2.6** presents common point and nonpoint sources of nitrogen and phosphorus loading and shows the approximate concentrations delivered. Note that nitrates are naturally occurring in some soils.

Nutrients Along the Stream Corridor

Nitrogen, because it does not sorb strongly to sediment, moves easily between the substrate and the water column and cycles continuously. Aquatic organisms incorporate dissolved and particulate inorganic nitrogen into proteinaceous matter. Dead organisms decompose and nitrogen is released as ammonia ions and then converted to nitrite and nitrate, where the process begins again.

Phosphorus undergoes continuous transformations in a freshwater environment. Some phosphorus will sorb to

Table 2.6: Sources and concentrations of pollutants from common point and nonpoint sources.

Source	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
Urban runoff[a]	3–10	0.2–1.7
Livestock operations[a]	6–800[b]	4–5
Atmosphere (wet deposition)[a]	0.9	0.015[c]
90% forest[d]	0.06–0.19	0.006–0.012
50% forest[d]	0.18–0.34	0.013–0.015
90% agriculture[d]	0.77–5.04	0.085–0.104
Untreated wastewater[a]	35	10
Treated wastewater[a,e]	30	10

[a] Novotny and Olem (1994).
[b] As organic nitrogen.
[c] Sorbed to airborne particulate.
[d] Omernik (1987).
[e] With secondary treatment.